

## **Solar America Initiative**

Solar Energy Technologies

STAGE GATE PROCESS

TEST & EVALUATION





## **Breakout Session Agenda**

- Introduction of Facilitator/Scribe
- Breakout group introductions: name and organization
- Session setup/ground rules
  - Purpose
  - Non-purpose
- Overview presentation of topic
- ID representative for report-out
- Discuss questions
- Summarize



# Purpose of Breakout Session



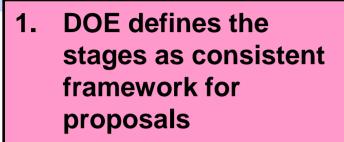
 Discussion of critical issues that will have a significant impact on the structure of the initiative and the resulting solicitation.

#### <u>Session Non-Purpose:</u> Topics not discussed or debated:

- Specific answers to questions posed by participants
- Provide information on the DOE procurement process
- DOE Solar budget or current program structure
- DOE Administration policy decisions
- Proprietary corporate or organizational information
- Sales or marketing speeches for participants' companies
- Present unverified technical data or assertions

## **Stage Definitions for PV**





2. TPPs define <u>YOUR</u> gates, criteria, timing, etc.

SG

SG

1 APPLIED RESEARCH

2 PRELIMINARY

INVESTIGATIONS

3 TECHNOLOGY R&D



N: Graduation from initiative. Possible gov't role through further loan guarantees for increased scale-up. ack from earlier production and tests; further lab and field testing/monitoring of overall system QC.

DEMONSTRATION: Establishment of full-scale production facilities through loan in at increments of ~25MW annual capacity. Completion of new round of ill components and systems to assure OC at high production rates.

OT PRODUCTION: Pilot-scale produ

ms. Completion of all associated lat elopment of pilot-scale facilities to

SG

operations; accelerated Proof-of-concept completed

**STAGE 2 PRELIMINARY INVESTIGATION** 

of laboratory investigations, physics-based n

s for commercial scale-up.

SG

DEVEL

Prototype System Developm

PV INDUSTRY AT COST GOALS AND HIGH VOLUME

STAGE 4 - Prototype System Development: Development and demonstration of integrated system (full-scale) prototype in a relevant operational environment.

Detailed design of integrated manufacturing processes, and demonstration of all key processes at sub-scale. Performance and cost of components (often produced in pilot-scale operations) support system prototype development. Test and evaluation efforts must validate performance and economic objective to accomplish SAI levelized cost of energy goals. Extensive use is made of accelerated lifetime and stress testing to improve reliability and mitigate potential field problems. Evaluate progress toward business plan (and refine) based upon prototype system development and manufacturing process demonstration results.



## Stage Gate in the SETP Basic Framework



## STAGE GATE WILL BE USED THROUGHOUT THE SOLAR ENERGY TECHNOLOGY PROGRAM

- DEVELOPMENT CYCLE goes from applied research investigations through massive production support activities
- Stage Gate is used throughout Development Cycle
- Work is done in "STAGES"
- Program reviews are done at "GATES"
- Increasing rigor, industry involvement, and expenditure are expected as development moves through successive stages

## DEVELOPMENT CYCLES



# Development Cycles in Photovoltaics are divided into "STAGES"

- In each "STAGE" you improve the maturity of:
  - Products
  - Processes
  - Business Planning
- Each "STAGE" has 1 or more "GATES" where decisions are made based on previously established criteria for:
  - Products
  - Processes
  - Business Planning



## Stage Gate Process

SG

SG

SG **4** PROTOTYPE

SYSTEM DEVEL

& PILOT PROD.



PV INDUSTRY AT COST

**GOALS AND HIGH VOLUME** 

### **Gates:**

More gates, more frequently at early stages

 Increased rigor in criteria, evaluation process, and industry cost share

3 TECHNOLOGY R&D

with successive gates

SG

SG

1 APPLIED RESEARCH

2 PRELIMINARY INVESTIGATIONS



**6 COMMERCIAL** 

PRODUCTION

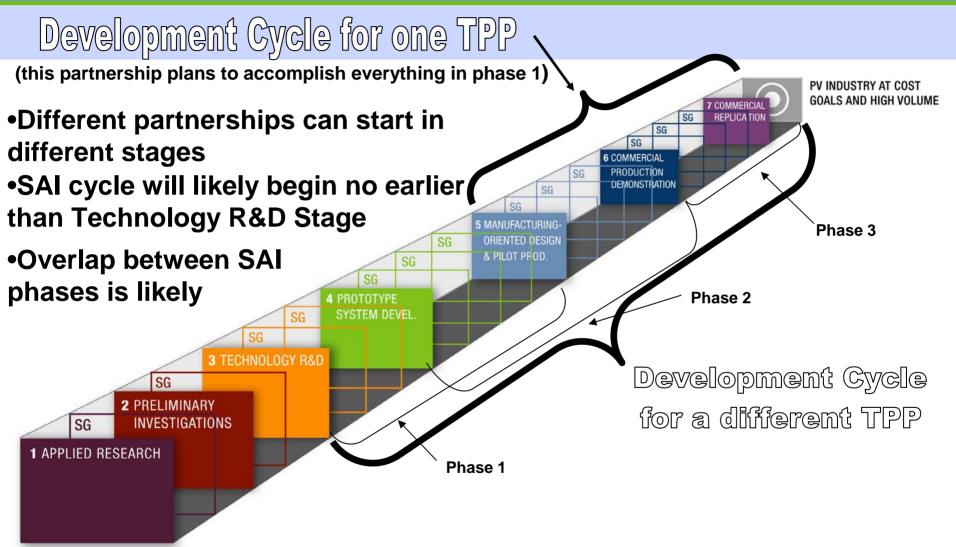
- Provide structure (stage definitions) for TPP proposals without over prescribing or over constraining
- Partnerships define Gates, Criteria, and Schedule
- SETP enforces accountability



#### **DEVELOPMENT CYCLES**

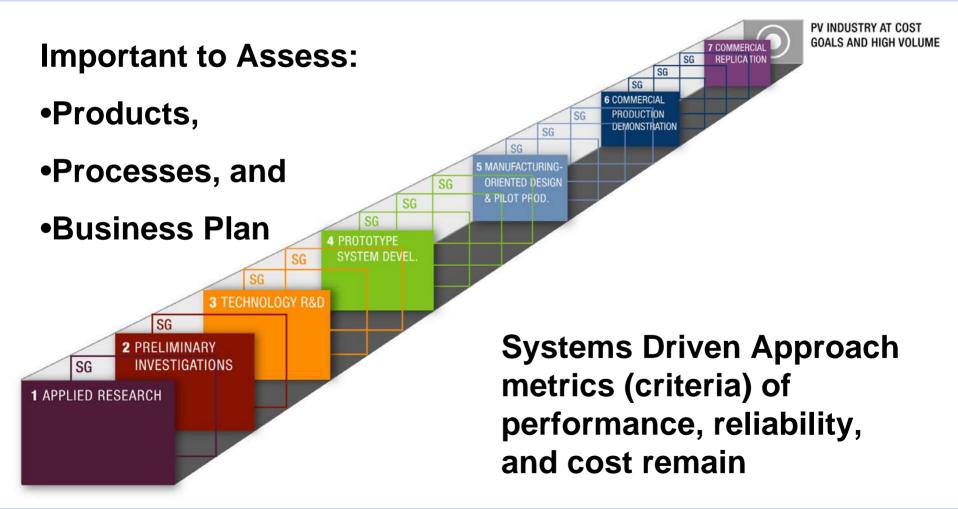


#### in TPPs



## **Metrics will be Critical**







## TPP Application of Stage-Gate CRITERIA



## Criteria for the TPPs must be SMART:

- S Specific
- M Measurable
- A Achievable
- R Relevant
- T Timetable

# Examples of Deliverables



### Hardware

 modules, inverters, BOS components, fully integrated prototype systems, commercial system, etc.

### Data

 efficiency, manufacturing costs, throughput, energy produced in field trials, operating environment, etc.

### Assessments relative to criteria

 analyses, data, independent evaluations, etc. validating that your criteria have been met or exceeded for products, processes, and business plan

## Criteria and plans for next stage efforts

 criteria, their basis and connection to program goals, process for determining if criteria are met, major technical barriers, plans for barrier removal, etc.

## At Each Gate Review



- Gate reviews are NOT STATUS REPORTS!!!!
- Projects must demonstrate they have met criteria of the current gate
- Make an informed decision on the future of the project
  - Pass, Recycle, Hold, or Kill
- Downselects will be implemented based (in large part) on gate review results
- Projects that "pass" the gate must have detailed plan for next stage of development



## **EXAMPLE: TPP Process with Stage Gate**



#### **Establish Baseline**

(stages and costs of your current technology)

**Develop Plan** (Goals, Strategy, and Gate Criteria)

#### **Perform Work**

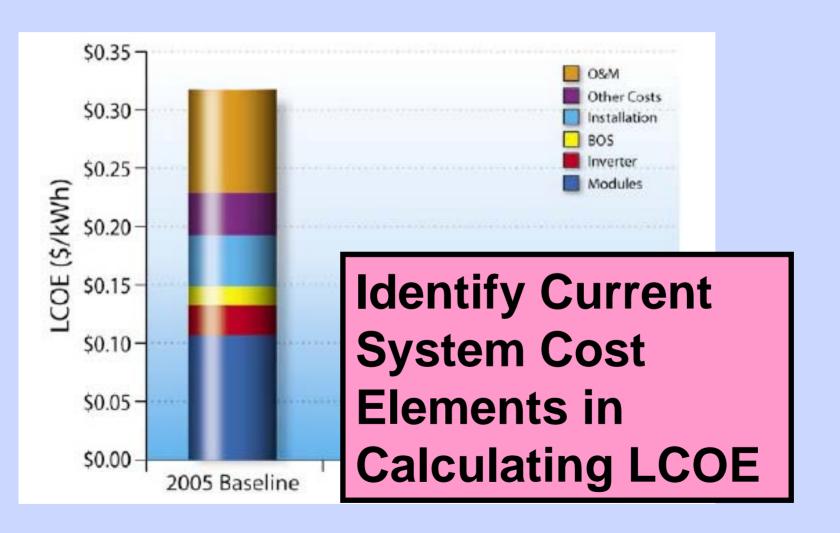
(component & manufacturing improvements, system design & integration, prototype development & test, etc.)

**Evaluate Progress Against Gate Criteria** 

#### Establish Baseline

(Cost, performance and reliability of your current technology)







## **Establish Baseline**



## Document <u>YOUR</u> starting points:

- •Cost
- Performance
- Reliability

System Element	Unit	TPP Baseline Parameters		
System Location & Orientation		Phoenix – latitude -15°		
System Size	kW	4		
Module Price	\$/Wdc	4.00		
Cversion efficiency	%	13.5		
Module size	Wpdc	100		
Inverter Price	\$/Wac	0.9		
Inverter size	kW	4		
DC-AC conversion efficiency	%	90		
Inverter life/replacement	Years	5		
Other BOS	\$/Wdc	0.61		
Installation	\$/Wdc	1.66		
Other/Indirect*	\$/Wdc	1.30		
INSTALLED SYSTEM PRICE	\$/Wdc	8.47		
Lifetime	Years	30		
Degradation	%/Yr	1		
System derate	%	5		
O&M Cost (not incl. inverter replacement)	% installed price	0.5		
LEVELIZED COST OF ENERGY (COE)	\$/kWhac	0.32		

"Other/Indirect" category includes design, engineering, site related costs, permitting, and profit.



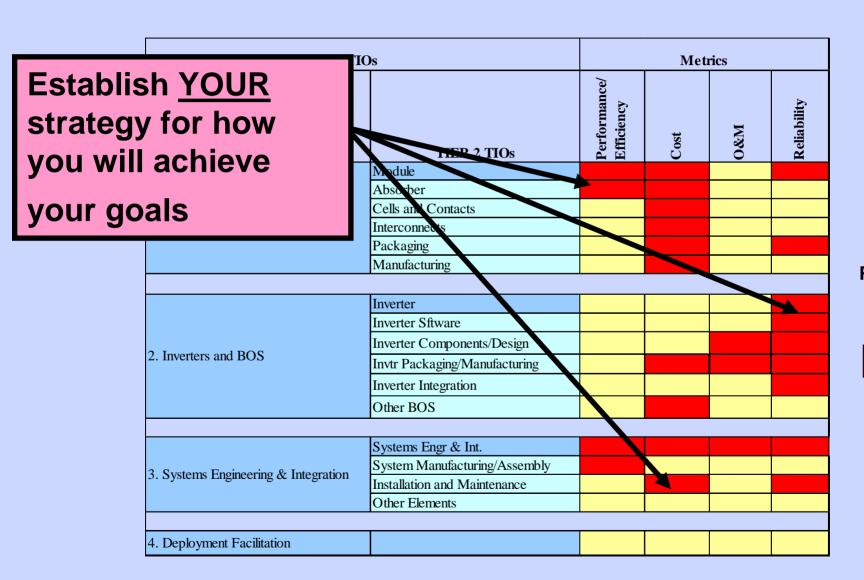


Curtain Floriant	Units	Decelies Developed	Phase 1  Goals	Goals 2015
System Element System Location & Orientation	Units	Baseline Parameters  Phoenix (Lande – 150)	Could	2010
System Size	kW	4	4.56	5.92
Develop <u>YOUR</u>	\$/Wdc	4.00	2.5	1.25
<del></del> 1	/6	13.5	17	20
near-term and	Wpdc	100	200	148
	\$/Wac	0.9	0.50	0.30
long-term goals	kW	4	4.74	6.00
	%	90	94	97
Inverter life/replacement	Years	5	20	20
Other BOS	\$/Wdc	0.61	0.55	0.33
Installation	\$/Wdc	1.66	0.32	0.42
Other/Indirect*	\$/Wdc	1.30	1.13	1.00
INSTALLED SYSTEM PRICE	\$/Wdc	8.47	5.00	3.30
Lifetime	Years	30	35	35
Degradation	%/Yr	1	1	1
System derate	%	5	5	5
O&M Cost (not incl. inverter replacement)	% installed price	0.5	0.3	0.2
LEVELIZED COST OF ENERGY (COE)	\$/kWhac	0.32	0.15	0.09



(Goals, Strategy, and Gate Criteria)

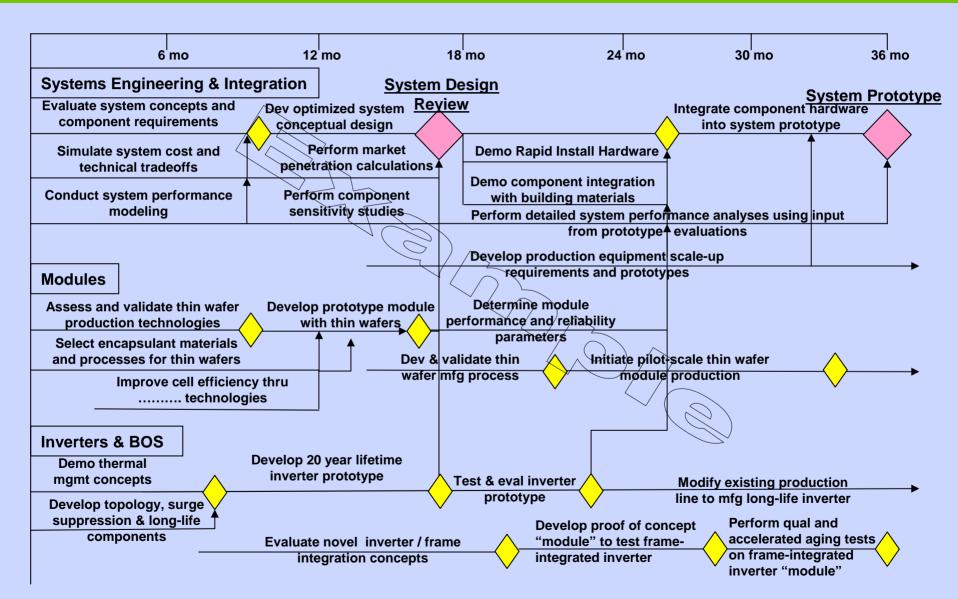




Area of High Potential Impact

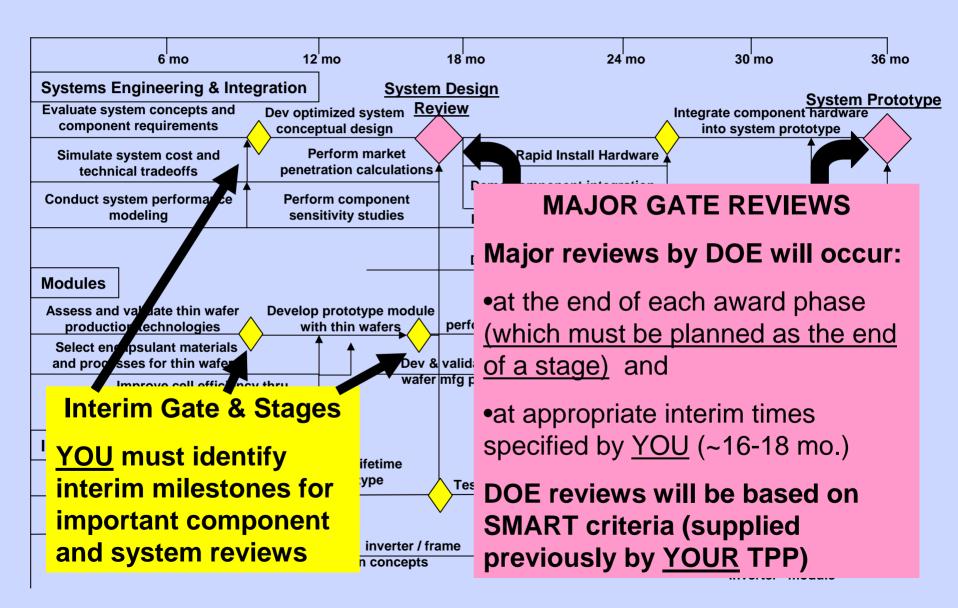








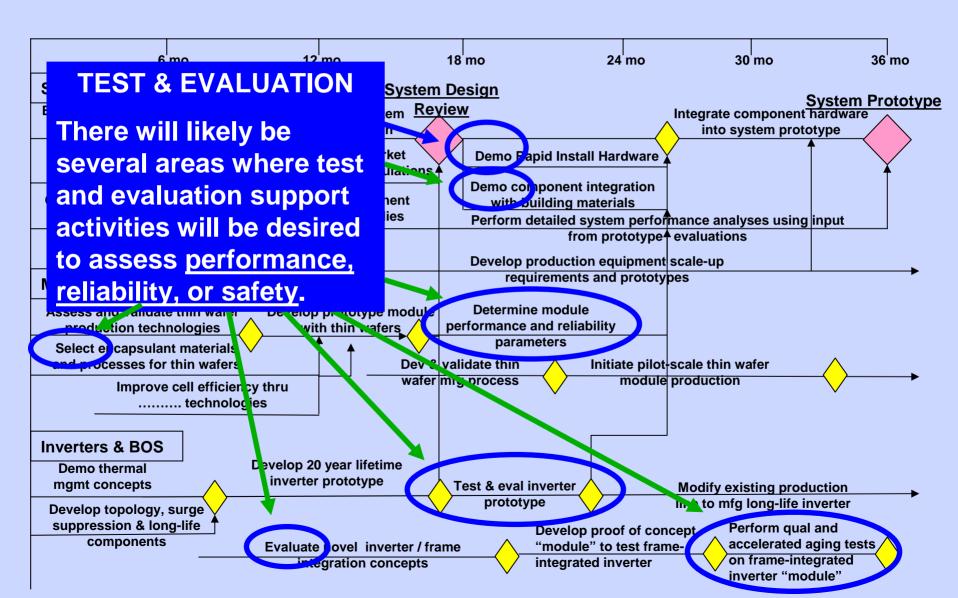






ria)







## Some Important Expectations for Validation Efforts



- Independent, credible validation of deliverables for performance, reliability, and safety
  - specify how you will validate your claims
  - •specify applicable codes, standards, or protocols
  - •Identify needed national lab, RES, and other testing support level & timing
- •Test and evaluation protocols all TPPs will actively participate in development
- •Transparent documentation of test & evaluation efforts w/o compromising proprietary data
- Validation approaches will be integral part of TPP award negotiations





## **Select Representative for Report-Out**

## We need YOUR help!



#### **Stage Gate Questions**

- •What difficulties do you see in fitting your project into the SG framework?
- •What further detail is needed in SG to facilitate your bid packages?
- •How can you effectively present SG material in your bids to facilitate effective technical tracking during the period of performance?
- •What types of SMART criteria at the system level will be most appropriate for gate reviews?
- •How can you best show how component improvements contribute to your overall system-level plan on this schedule? directly to the LCOE?

#### **Test & Evaluation Questions**

- •Do teams have an adequate understanding of the capabilities of the labs to conduct T&E? How can this understanding be improved?
- •How effectively can your team present a three-year T&E schedule, including lab participation, as part of your bid package? What is a reasonable expectation for this?
- •What types of specific protocols are needed to assure a level playing field for T&E activities?
  - For lab and field tests on new components and systems?
  - For handling of equipment and data?
  - For reporting, both to teams and to the SAI management?